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ABSTRACT

This paper presents an interim report of a nationwide study of microcomputer networking in American libraries and information centers. The purpose of the project is to evaluate the relevance of currently available networking systems for use in libraries and information centers. Two major aspects are investigated. First, using a sample of libraries and information centers, the need for microcomputer networking is being assessed. Second, microcomputer networking manufacturers and vendors are being investigated to identify systems that can be adapted/adopted for library/information center applications. Preliminary results indicate that data sharing is the most important reason for microcomputer networking in libraries. The final report will provide guidelines on evaluation and selection of networking systems. The text is supplemented by one figure and two tables. (13 references) (Author/EW)

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MICROCOMPUTER NETWORKING

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ABSTRACT

The proliferation of microcomputer use in organizations has resulted in the need for networking them for optimum effectiveness. This paper presents an interim report of a study of microcomputer networking systems in American libraries and information centers. This nation-wide study is funded by the City University of New York Research Foundation and started in July 1986. The purpose of the project is to evaluate the relevance of currently available networking systems for use in libraries and information centers. Two major aspects are investigated. First, using a sample of American libraries and information centers, an attempt is made to assess the need for microcomputer networking. Second, microcomputer networking systems vendors/ manufacturers are investigated to identify systems which can be adapted/ adopted for library/information center applications. Preliminary results indicate that data sharing is the most important reason for networking micros in libraries. The final report will provide guidelines on evaluation and selection of networking systems.

INTRODUCTION

This paper presents preliminary results of a study of microcomputer networking systems in American libraries and information centers. The aim of this nation-wide study is to evaluate the relevance of currently available systems for library use. There are two major aspects to the study. First, using a representative sample (600) of United States libraries and information centers, it is intended to assess library need for microcomputer networking. This has been done by a combination of questionnaire, interviews and site visits. Second, it is intended to investigate a broad representation (200) of microcomputer networking systems manufacturers/vendors to identify systems which can be adapted/adopted for library applications. This has been done by questionnaire, interviews, site visits and demonstrations. Only four sites have been visited for demonstrations. The study which is funded by the City University of New York started in July 1986.

In pursuit of the two basic aspects of the study, the main focus has been on the following objectives:

1. To identify the variety of microcomputers currently in use in libraries and information centers in the United States.
2. To identify functions and services which require microcomputer networking as perceived by librarians and other information specialists.
3. To identify which libraries and information centers already use microcomputer networking systems.
4. To identify what microcomputer networking systems, if any, are currently in use and for which functions.

5. To investigate the availability of in-house developed microcomputer networking systems. If such systems exist, are they available for purchase or lease to other libraries.
6. To identify advantages/pluses or disadvantages of using microcomputer networking systems as perceived by librarians and other information specialists.
7. To identify microcomputer networking systems which can be adopted/adapted for library applications.
8. To appraise cost estimates for the relevant systems.
9. To appraise software and hardware features required for the suitable systems.
10. To produce a comprehensive report which can be used by librarians and other information specialists in evaluation and selection of microcomputer networking systems.

BACKGROUND TO THE STUDY

Microcomputers in General

Microcomputers are becoming increasingly popular in libraries and information centers. Modern librarians and information specialists serve very sophisticated information seekers. Accurate information must be obtained fast from a variety of sources. Traditional manual systems are very slow to respond to the requirements of a sophisticated user. Librarians and other information specialists have inevitably resorted to computers to speed up their information processing activities. In the 1970's and early 1980's, most computer systems used in libraries and information centers were developed on mainframe or minicomputers. The price tag on these systems ranged from tens of thousands to millions of dollars.

At such prices, only well endowed university or college and wealthy public libraries could afford to computerize.

Microcomputer use has come as a result of relatively recent developments in computer hardware and software, particularly in the 1970's and early 1980's. Computer circuit designers have successfully experimented with large scale integrated circuits (LSI) and later very large scale integrated circuits (VLSI)(1). Using LSI and VLSI technology, it is possible to compress more electronic circuits on a single silicon chip. This in effect puts more computing power on fewer chips. These high density chips are used in creating microprocessors. Such microprocessors are in turn used as the building blocks for microcomputers and associated devices.

LSI and VLSI technology based devices are characterized by smaller sizes, large memories and faster response times. The tendency to miniaturize computer components which have more power is clearly manifest in the microcomputer memories. The earlier micros had main memories of 8K as standard memories. Memories have advanced to 64K, 128K, 256K and 512K. Megabyte (million bytes) memories are currently contemplated by manufacturers as a possible standard for the late 1980's(2). Word sizes have likewise progressively increased from 8-bit, through 16-bit to currently 32-bit for the super micros.

In addition to hardware, software developments have favored microcomputer use. In response to microcomputer hardware development software houses have sprung up on the computer scene to cater for the new software market. Corporations like Microsoft, Digital Research, Ashton Tate, and Lotus Development Corporation are household names in data processing shops. These

houses have strived to develop software for users who need not be computer scientists. Ease of use has been one of the main features of this type of software and the term "user friendly" has been coined to denote it.

Concurrent improvement of microcomputer hardware and software has resulted in the availability of sophisticated software packages. Such packages can perform a multitude of functions like accounting, word processing, data base management and communications. Due to the size of their memories earlier microcomputers could not accommodate some of the modern packages. For instance Wordstar which needs a minimum of 64K of main memory could not be used on earlier microcomputers. Similarly, Lotus 1-2-3 which requires a minimum of 128K of memory could not be used on some of the early micros.

Information Specialists' Response to Microcomputers

The advent of the microcomputer has spread automation to academic libraries, public libraries and information centers with moderate budgets. The micro has all the desirable attributes for incorporation in library and information services operations. It is cheaper, "user friendly," and takes less space than either a mainframe or minicomputer. As Allan Pratt put it,

> Micros, like other computers are designed for the rapid and accurate handling of large volumes of data. It is only to be expected that a profession whose primary focus is in doing just that would rapidly adopt these inexpensive and powerful systems(3).

The escalation of the use of microcomputers was presaged by OCLC's announcement in mid-summer 1983 that it will adopt the M 300 as the standard terminal(4). This is a modified IBM PC which with a keyboard overlay can be

used like any other IBM personal computer. By this time, however, a variety of other microcomputers were already in use in libraries and information centers. This trend has continued and one does find the IBM products, IBM compatibles and independent non-compatible micros side by side.

In terms of general library set up, microcomputers are used in administration, technical services, public services and patron use(5). As regards specific applications, micros have been used for word processing, spread sheets, data base management systems and communication with larger computer systems. For the first three applications the micro is used as a stand-alone device. As for communication, it is usually utilized in a terminal emulation mode to access remote computer data banks. Many information specialists use the micro to search services such as DIALOG, BRS, LEXIS and others.

Increasing sophistication of the microcomputer hardware and software has been received by an increase of enthusiasm by information professionals. Several local, regional and national conferences are held on micros annually. There is a proliferation of microcomputer users' clubs. As the editorial column to Small Computers in Libraries commented,

> The number of new products and services featuring microcomputer at the American Library Association's mid-winter conference (January 5-10, Washington, D.C.) underscores the overwhelming acceptance of this new tool by all types of libraries. It seems as though each exhibit contained at least one Apple or IBM running a variety of processing support programs or access services to databases(6).

Microcomputer Networking Systems

The development of microcomputer networking is a logical progression from the increased use of micros in libraries and information centers. In his overview article on the use of micros in libraries, Allan Pratt predicts that the micro will soon be a routine working tool in many libraries. Pointing to the need for networked micros he stresses that, "The critical need is for access and the sharing of large databases(7). This prediction is reinforced by Datapro Research Corporation's futuristic forecast stating that,

> By the late eighties or early nineties it will be possible to have a microcomputer on one's desk with capabilities beyond the mainframe computers of only a few years before. The horizons opened by these developments will make access to information available on a scale never before possible. In principle, at least, it should be technically possible to simply order up a copy of all the works of the Library of Congress (or significant portions thereof) and to house it in a relatively small space. If software developments keep up with the hardware, the possibilities for not only large (and small) organizations but for society as a whole are limitless(8).

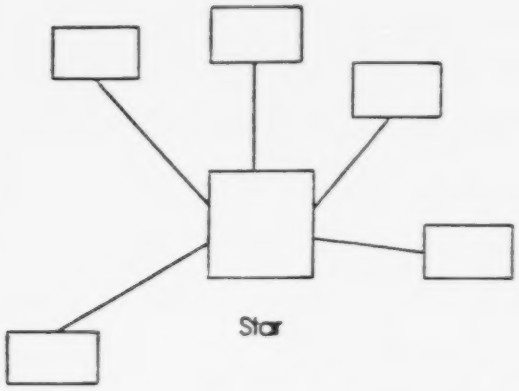
Microcomputer networking systems are a subset of the general concept of local area networks (LANS). A local network has been defined by William Stallings thus, "A local network is a communication network that provides interconnection of a variety of data communications devices within a small area(9).

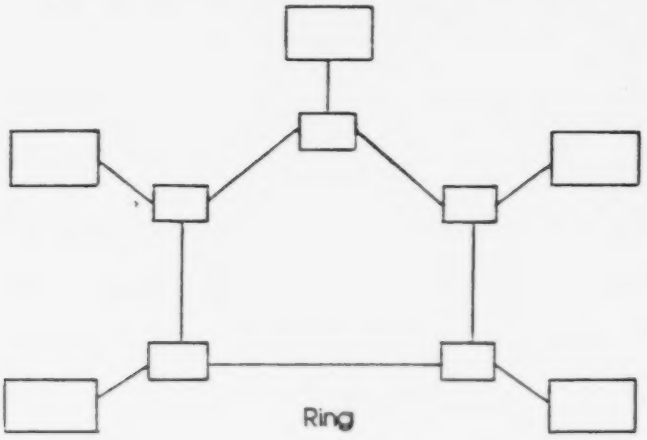
Two main objectives may be isolated for using microcomputer networking systems in libraries and information centers. First, they facilitate the sharing of expensive peripheral devices such as printers, high density storage devices, modems and communication lines. Second, they permit convenient sharing of commonly used data(10). In addition, they provide the potential for connecting devices from multiple vendors(11).

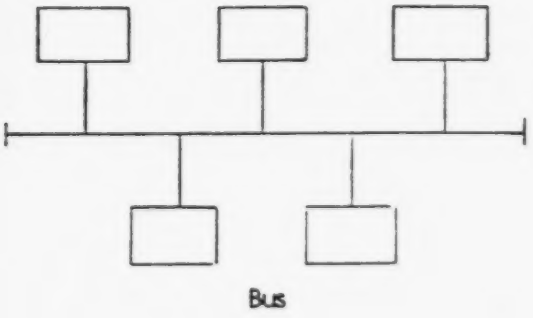
In the early 1980's, microcomputer networking systems were experimental. By the mid-1980's, however, they had moved very rapidly from experimental stage to commercial availability(12). This is true for both mainframe and micro-based networks. As computer software and hardware become more sophisticated, we can thus expect more demand for microcomputer networks in the information field.

Local area networks are characterized by three basic topologies or configurations namely: The star, the bus/tree and ring(13). These topologies are demonstrated in figure 1. A star is a group of connected devices (nodes) served by a central device sometimes referred to as a host (computer). On the other hand, a bus/tree topology has a multiple-access, broadcast medium. Since all devices share a common communication medium, only one device can transmit at a time. As figure 1 indicates, the bus is the special case of the tree with only one trunk. Finally, the ring consists of a closed loop with each node attached to a repeating element.

Another important feature of networks is the transmission media. Surveying current literature reveals that there are three types of media suitable for networks, the twisted pair wire, coaxial cable and optical fiber(14). The twisted pair wire is one of the common transmission media. It's main







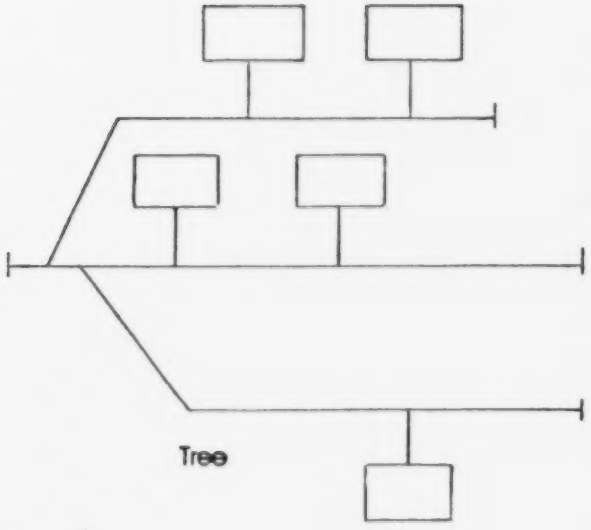


Figure 1. Local network topologies.

weakness is that it is susceptible to noise. However, with proper shielding this defect can be minimized. Coaxial cable can achieve higher performance by providing higher throughput, supporting a larger number of devices and spanning greater distances than twisted pair wire. Although it is very expensive, optical fiber has even higher potential, for it carries a larger number of devices, has light weight, small diameter and is more resistant to noise than the other two.

It is important to note that choices of transmission medium and topology can not be done independently. For instance, twisted pair wire is more suited to the star topology than coaxial cable or optical fiber. This is due to the fact that the star topology requires a single point to point link between each device and a central switch. The higher data rates of coaxial cable or optical fiber would overwhelm the switches available with today's technology.

There are approximately over 200 LANS products vendors in the U.S. today. 50% of these vendors have personal computer local area networks products and 20% specialize in such products. While manufacturers/vendors with dual roles have been researched, the main emphasis has been on microcomputer LANS specialists.

In my book The Information Dilemma, (Greenwood Press, 1983), I discussed several issues on the information arena(15). One of the issues discussed at length was data communications and the concomitant need for computer networks. The current research expands and elaborates many of the concepts in the book. Microcomputer based LANS are definitely the ultimate in computer networking for optimum user satisfaction. They alleviate some of the problems of user access to information discussed in the book.

PRELIMINARY RESULTS

While all the data is not in yet, preliminary questionnaire and interview results, as well as literature search, indicate a number of interesting tendencies. For analytical purposes, a random subset of forty-eight respondents was selected from the (373) returned questionnaires. Computer analysis of this data is shown on tables 1 and 2.

A. Rationale for Networking Microcomputers

Librarians and information specialists are very keen on LANS. They have expressed frustration that several of their microcomputers cannot communicate with each other. Those who can transmit messages using PBXs think that this is somewhat limited and see LANS as one of the logical alternatives. The following have been given as the main reasons for networking microcomputers (see rows 2-6 respectively):

(1) To access common data, examples - online public access catalogs, acquisitions, and serials information.

(2) To share expensive devices, examples - hard disks, high quality printers.

(3) To share software (program packages) examples - Word Processing, accounting, communications.

(4) Electronic mail among departments and with patrons.

(5) Uploading and downloading to and from other systems, examples - OCLC, RLIN, DIALOG, the Source.

With 95% of the respondents agreeing, the research indicates that access to commo data is the single most important reason for networking micro-compu rs. Sharing software had 60% consent level indicating caution with regar to copyright provisions.

B. Current Usage of LANS

As indicated by row 7, the number of libraries and information centers which are already using LANS is relatively small (23%). Of the institutions surveyed, there was a marked concentration among academic libraries and few public or special libraries. However, as indicated by row 8 over 50% of the sample subset have definite plans to use LANS. A considerable number of institutions are in the middle of negotiations with vendors.

Some of the current users in the sample were:

Allegheny General Hospital, Health Sciences Library (Pittsburgh, PA)

AT&T Bell Labs Information Center (NJ)

California Institute of Technology (CA)

Dow Chemical Company Information Center (MI)

Ford Motor Company Information Center (MI)

Georgetown University Medical Center (Washington, D.C.)

Humboldt State University (CA)

Lexington Public Library (KY)

Massachusetts Institute of Technology (MA)

Monsato Company Information Center (MO)

New York University Library (N.Y.)

Northern Illinois Library System (IL)

Oregon State University (OR)

University of California, Los Angeles (CA)

University of California, San Diego (CA)

University of Kentucky (KY)

University of New Mexico (NM)

University of Virginia, Charlottesville (VA)

C. The Vendor Market

The market for LANS is in a state of flux and confusing. Whereas the potential for them in library automation is tremendous, the market has several sleek ads and aggressive salespeople. Extreme caution is needed to distinguish between genuine LANS products and products which vendors claim to be LANS but are in fact multi-user systems.

As for the types of LANS currently in use in libraries/information centers, Ethernet appears to be the most popular so far. Most commonly cited vendors include: Corvus Systems, Nestar Systems, Novell, 3 COM and Ungermann-Bass. IBMs token-ring is receiving much attention due to the prestige of the vendor, but has relatively few installations. AT&Ts LANS are incorporated in campus-wide networking systems which are relatively few.

D. Current Problems

The basic problems so far examined center around the following:

(a) Estimating the workload of the library/information center.

(b) Designing the LAN, in collaboration with technical personnel.

(c) Identifying suitable LAN software and hardware.

(d) Selecting a reliable vendor.

(e) Lack of standards among currently available LANS.

(f) Maintaining data security after installation.

Some of the solutions to these problems, as revealed by the research findings, will be discussed in the final report after more data is received and analyzed. At the time of writing, more interviews for libraries/ information centers and demonstrations by LANS vendors are scheduled and should be completed by December 1987.

TABLE 1. DATA ANALYSIS I

1. OTHER	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
	27	.	.	.
AT&T	1	4.8	1	4.8
COLU	2	9.5	3	14.3
COMM	1	4.8	4	19.0
COMP	3	14.3	7	33.3
LEAD	1	4.8	8	38.1
NORT	1	4.8	9	42.9
SPER	1	4.8	10	47.6
TELE	2	9.5	12	57.1
WANG	5	23.8	17	81.0
ZENI	4	19.0	21	100.0

2. ACCESS	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
N	2	4.2	2	4.2
Y	46	95.8	48	100.0

3. SHRDEV	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
N	14	29.2	14	29.2
Y	34	70.8	48	100.0

4. SHRSOFT	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
N	19	39.6	19	39.6
Y	29	60.4	48	100.0

5. ELECMAIL	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
N	10	20.8	10	20.8
Y	38	79.2	48	100.0

TABLE 2. DATA ANALYSIS II

6. UPDNLOAD	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
N	6	12.5	6	12.5
Y	42	87.5	48	100.0

7. PRESLAN	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
	1	.	.	.
N	36	76.6	36	76.6
Y	11	23.4	47	100.0

8. LANPLANS	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
	9	.	.	.
N	19	48.7	19	48.7
Y	20	51.3	39	100.0

9. OBJECTN	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
	22	.	.	.
COSTH	3	11.5	3	11.5
NOASS	11	42.3	14	53.8
NOTAP	1	3.8	15	57.7
OTHER	11	42.3	26	100.0

10. WANTREPT	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
	4	.	.	.
N	6	13.6	6	13.6
Y	38	86.4	44	100.0

NOTES

(1) Carver Mead and Lynn Conway, Introduction to VLSI Systems (Reading, Mass.: Addison-Wesley, 1980), 1-50.

(2) Datapro Research Corporation, Management of Microcomputer Systems (Delran, N.J.: 1985), 1, Hardware.

(3) Allan Pratt, "Microcomputers in Libraries," Annual Review of Information Science and technology. 16 (March 1984) 247.

(4) Ibid., 253.

(5) Ibid., 252.

(6) Small Computers in Libraries, 5 (February 1985) 3, Editorial Note.

(7) Pratt, "Microcomputers," 261.

(8) Datapro Management, 103.

(9) William Stallings, "Local Networks," Computing Surveys 16 (March 1984) 4.

(10) Maris Graube and Michael C. Mulder, "Local Area Networks," Computer 17 (October 1984) 242.

(11) Stallings, "Local Networks," 5.

(12) William Stallings, Local Networks: An Introduction, (New York: Macmillan, 1984) 1-50.

(13) Graube and Mulder, "Local Area Netowrks," 243.

(14) Stallings, "Local Networks," 7.

(15) Harry M. Kibirige, The Information Dilemma: A Critical Analysis of Information Pricing and the Fees Controversy (Westport, Conn.: Greenwood Press, 1983).